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THE TREATMENT OF LATENT OR TERTIARY SYPHILIS.

The treatment of syphilis in the latent and tertiary stages is more a private medical problem than a public health problem, for only in the early stages is the disease highly infectious. While infectiousness is demonstrable in latent, tertiary, or "para-syphilis," it must be disregarded because of the economic limitations of the present-day program for the control of the disease. If all cases of syphilis in the earlier or florid stages could be treated adequately, the problem of control could be solved; and this properly may be the aim of our efforts. On the other hand, the discussion of the many details of the treatment of such affections as nervous, vascular, or heriditary syphilis can not be covered adequately in a short series of notes.

HYPOCHLORITE PROCESS OF OYSTER PURIFICATION.

REPORT ON EXPERIMENTAL PURIFICATION OF POLLUTED OYSTERS, ON A COMMERCIAL SCALE, BY FLOATING THEM IN SEA WATER TREATED WITH HYPOCHLORITE OF CALCIUM.

By F. A. Carmelia, Passed Assistant Surgeon, United States Pubic Health Service.

Introduction.

Raritan Bay is one of the important oyster-producing areas of the country, and, owing to its proximity to New York City and contiguous urban centers, it became, with the growth of those communities, increasingly more desirable from a commercial standpoint and less desirable from the public health standpoint.

Recently, as shown by the *B. coli* content, the sewage pollution present in the waters and shellfish of the Raritan Bay area was reported generally to have reached the permissible limit from the public health standpoint, and in considerable areas it had exceeded such limits. The problem of what to do with the bay as a shellfish-producing area was becoming increasingly urgent, as it was not believed practicable to cause the abandonment of the area for shellfish culture.

To the already urgent problem was added the belief that the completion of the Passaic Valley sewerage project, adding about 300 million gallons of sewage per day to the waters of New York Bay, would make imperative the adoption of further safeguards to protect public health from the possibility of contracting infectious disease through the marketing of shellfish from this area.

The Passaic Valley sewerage project is a collecting trunk sewer serving several large congested urban populations in the Passaic River Valley, discharging through multiple dispersion outlets into the waters of Upper New York Bay along the westerly edge of the ship channel opposite Robbins Reef and about 2 miles above the Narrows leading direct to the waters of Lower New York Bay, which include Raritan Bay. Owing to the length of the sewer trunk (several miles), the sewage would be discharged in a fine state of subdivision, tending toward a maximum area of diffusion in those tidal waters.

Accordingly, the health authorities concerned issued notice that direct marketing of shellfish from the waters of Raritan Bay would probably have to be prohibited in order to safeguard public health, unless such shellfish were subjected to some acceptable method of purification. This notice focused interest upon available methods of oyster purification. Of the two methods known, that of purifying polluted oysters by means of floating them in natural waters of acceptable freedom from sewage contamination was impracticable because there were no such natural waters in that area. There remained, therefore, but to consider the feasibility of purifying polluted oysters on a commercial scale by floating them in natural waters rendered safe through treatment with hypochlorite of calcium.

Oystermen in the area had learned of the possibility of oyster purification by the hypochlorite method demonstrated by the United States Public Health Service in the contiguous area, Jamaica Bay, in 1916. They met and selected a committee to seek aid from the State Conservation Commission of New York.

The State Conservation Commission arranged to conduct a series of demonstrations on a commercial scale, selecting Great Kills Harbor, a small harbor on Raritan Bay, as the site. The Department of Health of the city of New York, the Bureau of Chemistry of the United States Department of Agriculture, and the United States Public Health Service were duly invited to make observations covering the acceptability of the process from the public health standpoint.

Personnel.

Commissioner George D. Pratt, of the State Conservation Commission, designated Sanitary Chemist William F. Wells, formerly of the Public Health Service, to conduct the demonstration; the Bureau of Chemistry designated Dr. Payn Parsons to make observations on the acceptability of the process; and the writer was detailed by the Public Health Service to cooperate with Dr. Parsons in making the observations. The State Department of Health of New York did not make observations of the series of demonstrations; a representative was present at one special demonstration but took no samples of the oysters. The New York City Department of Health secured samples of the treated oysters upon marketing and were represented at but two of the series of demonstrations.

The Site.

Great Kills Harbor is a shallow, landlocked body of water about one-half mile in width and 2 miles in length, having a narrow entrance from Raritan Bay. The tidal replacement of its waters is estimated to be 66 to 75 per cent of total high-water volume. There was moderate pollution along the foreshores and from about a score of small pleasure yachts anchored in the harbor. The harbor water at low tide was, on the average, positive for *B. coli* in amounts of 1 c. c. (sometimes in three-tenths c. c.), and at high water it was positive in amounts of 3 c. c. (frequently in 1 c. c.). There was a moderate degree of turbidity present which was mostly due to suspended organic matter. Wind was of little import in the water pollution, as was also tidal flow, locally.

Experimental Equipment.

Two tight oyster floats of scow type, 50 feet by 9 feet by 2 feet 6 inches, were moored out in the upper center portion of the harbor, which was less frequented by boats and distant from sources of shore pollution. The mean low-water depth was 4 feet, and the tidal range varied from 5 to 6 feet. The harbor bottom was soft mud, 18 inches to 3 feet in depth. Each scow had 4 bungholes, 2½ inches in diameter, stopped with wooden plugs. One scow was equipped with a small gas engine and a rotary pump, piped to fill with and discharge sea water and also to circulate water within the hold. It could not be made to operate satisfactorily, and so in both scows filling was accomplished through temporary removal of the plugs, and the water was discharged with pails and hand pumps. In such scows containing water for floating, 60 to 75 bushels of oysters can be handled.

A supply of 12-ounce containers of commercial hypochlorite of calcium, a pestle and a mortar for pulverizing and mixing the hypochlorite, a pair of ordinary 6-foot rowing oars, and a glass container for testing satisfactory diffusions of the hypochlorite in the floating water by means of a one-tenth of 1 per cent solution of orthotoludine in 10 per cent hydrochloric acid completed the equipment used, in addition to the ordinary oyster-dredging equipment.

The laboratory control of the process was conducted by Dr. Parsons, who used the laboratory of the eastern division of the Bureau of Chemistry in New York City, and by the writer, who availed himself of the laboratory facilities of the United States marine hospital at Stapleton, N. Y., about 8 miles from Great Kills. The standard methods of the American Public Health Association were used in the examination of the oysters.

In addition, market samples of treated oysters were examined by the New York City Department of Health.

Owing to the cost of out-of-season dredging and handling of the oyster stock for the experiment in large commercial quantities, oystermen as a group did not feel inclined to undergo experimental expense; and no other means were available for securing the oyster stock. This part of the demonstration seemed to have greatly hampered the possibilities of the experiment. Two oystermen, however, took really active interest in the project: To Mr. A. F. Merrill, of the Merrill-Haviland Oyster Co., belongs due credit, for he alone provided the essential oyster stock and necessary handling and floating equipment; and credit is also due Mr. John Schmeelks, of Jamaica Bay, for securing special lots of markedly polluted oysters made available in the series of experiments.

Conduct of the Experiment.

As it was ascertained that the tide made but slight variation in the amount of sewage pollution as evidenced by the *B. coli* content present in the waters of Great Kills, it was disregarded in conducting the experiment.

From 60 to 150 bushels of oysters were procured by the usual method of oyster dredging, from the oyster grounds of the Raritan Bay area. (A few other demonstrations were made with oysters from the most markedly polluted areas obtainable.) This dredge load of oysters was then brought in directly to the floats. Meanwhile the floats had been rendered relatively fresh and clean by being washed down with harbor water prior to placing any oysters in them. From 50 to 75 bushels of oysters were then evenly placed in the floats to a depth of 6 to 8 inches. The plugs were then pulled and the float was allowed to fill through the plug openings until several inches of water covered the top oysters, the amount of water being approximately 50 gallons to the bushel of oysters. The plugs were then securely replaced. Tight floats without leaks are essential.

A 12-ounce container of hypochlorite of calcium was then opened, and from one-third to one-half of its contents was placed in a mortar. This quantity gave from 4 to 6 parts per million of available free chlorine (assuming a 30 per cent commercial product). A sufficient quantity of water was added to the mortar to make a smooth paste, and this mixture was then quickly added, in scattered, roughly equal portions, to the water in the floats containing oysters. This was then diffused as rapidly and thoroughly as possible by means of stirring with oars. Usually 10 to 15 minutes of stirring proved sufficient.

Within from 20 to 30 minutes following the addition of the hypochlorite paste, water from various parts of the float was tested for the presence of free chlorine, using the orthotoludine test. A glassful of the treated water was taken up, and from 5 to 10 drops of one-tenth of 1 per cent solution of orthotoludine in 10 per cent hydrochloric acid was added, which, in the presence of very small quantities of residual excess of free chlorine in the treated water, colors the water a decided straw color. The smaller the amount of residual chlorine present, the slower was the straw-colored coloration of the sample of water tested.

It is desirable to have a small residual amount of chlorine remaining in the treated water at the end of a 20-to-30-minute period. Should the test then not indicate such excess of chlorine, sufficient additional hypochlorite of calcium should be added until such excess is obtainable. There is one caution in the application of the test: Avoid taking up any small particles of unreduced hypochlorite of calcium which may occasionally be found remaining in the treated water at that stage. Such particles give a pronounced test for chlorine, which may at times erroneously indicate the desired average excess of chlorine in the treated water.

It is highly desirable that the entire step of evenly charging the water with hypochlorite of calcium be done with as little delay as possible, as the chemical is most active in the period immediately following its mixture with the water.

The amount of free and suspended organic matter present in the water to be treated directly should govern the judgment as to the amount of hypochlorite of calcium it is necessary to add to give the desired excess of chlorine at the termination of the 20-to-30-minute period. The greater the amount of organic matter present, the larger the quantity of hypochlorite indicated.

The excess of chlorine present at the termination of the 20-to-30-minute period disappears in a comparatively short time. The end products of the process consist of correspondingly small amounts of calcium carbonate and sodium chloride and are indistinguishable, both qualitatively and quantitatively, from such salts already present in comparatively large amounts in natural sea water; therefore there is no question of adulteration or otherwise changing the taste or quality of the oysters placed in such treated waters.

Following the first treatment of the water with hypochlorite, nothing further is done for a period of about 6 hours, and the oysters are allowed to remain undisturbed, which aids in their purification. At the end of 6 hours a second treatment of the water with hypochlorite, identical with the first, is then made. Following the second treatment, the treated water containing the oysters is again allowed to remain undisturbed for an additional period of from 12 to 18 hours.

At the end of this final period, totaling 18 to 24 hours from the first step in the process, the oysters are ready to be removed and marketed. It is best that their removal be accomplished with the least practicable disturbance of the water in which they have been floated. Oysters should not remain in the treated water longer than 24 to 30 hours.

Prior to the removal of the oysters from the floats at the expiration of 18 to 24 hours, it was routine to test (with the orthotoludine test) several parts of the treated water for the presence of excess of chlorine. In no instance was there found any trace of the presence of free chlorine in the water.

It is of further aid in the case of oyster stock covered with much débris and similar organic matter to wash such material off the shells in a reasonably thorough manner with ordinary clear sea water before placing such oyster stock in the floats for treatment.

Biologic Principles Involved.

The oyster, by reason of its biologic principles of growth and life, is practically a small pump with a sieve or strainer on the intake line. The flow of water set up between the shells of the oyster for the oxygenation necessary to its metabolism is, at the same time, strained of the minute organisms present therein, constituting the food supply. Any other fine particles suspended in the water, including sewage when present and bacteria, are at the same time strained out with its food supply. The material so strained passes through the alimentary canal of the oyster, being utilized as suitable for food supply, or rejected and passed through. Occasionally irritant particles are strained out of the water. These are summarily and forcibly ejected almost immediately after their entrance into the shells, without passing through the alimentary canal. Bacteria and nonfood particles entering the alimentary canal are apparently passed through and ejected practically unchanged in from four to six hours. It is estimated that about 50 gallons of water each 24 hours is passed between the shells of an oyster during the active feeding season. The amount of water so passed varies directly with the temperature of the water and oyster. Below temperatures of 40° to 45° Fahrenheit very small quantities of water are passed, barely sufficient to supply oxygenation necessary to support the dormant metabolism of the so-called hibernation stage. This explains the apparent improvement noted in oysters grown in polluted areas during such low temperatures.

Results of the Process.

The hypochlorite of calcium practically sterilizes and clears the sea water in which the oysters are placed. The water, for a brief period following the addition of the hypochlorite, is more or less irritating to the oyster, which repeatedly and forcibly rejects the water. This removes mechanically gross particles, such as mud and the like, from within the outer chamber between the shells, and for this reason the oysters when opened present a nice, clean appearance. Likewise the organic matter on the outside of the shells is loosened and more or less disintegrated and falls from the shells, leaving the external appearance of the oyster stock considerably improved for marketing and removing to a considerable degree the danger of contamination of the oyster meats during shucking.

With the disappearance of the excess of chemical from the water, the oyster resumes "drinking," i. e., passing water between its shells. The water is now practically sterilized and clear of suspended organic matter, and in passing through the oyster it mechanically cleans the outer and inner chambers between the shells of practically all material usually present therein. This material and the contents of the alimentary canal, having been within the oyster, were not sterilized by the first application of hypochlorite, and upon ejection into the water in which the oysters are floated, again pollute the water moderately. This necessitates the second application of hypochlorite, following which the water and oysters are both comparatively clean and sterile. The washing process incident to the oyster's drinking the treated water is then permitted to continue for the duration of the second period of from 12 to 18 hours, following which the oysters are removed for marketing.

The bacteriological results obtained by the above-described treatment of oysters showing accepted evidence of pollution are best visualized in the accompanying table, which is self-explanatory. Several samples were taken from different parts of the float, both before and after treatment, in a series of 13 runs from August 9 to September 23, 1920, and the average bacteriological results obtained in each run are tabulated.

Bacteriological results of hypochlorite process of oyster purification.

Run No.	Average B. coli score of oysters before treatment.	Average B. coli score of oysters after treatment.	Quantity of oysters treated (bushels).	Average per cent reduction of B. coli after treating.	Source of oysters.
1	23	2	46	91.3	Raritan Bay between Great Kills and Princess Bay.
2	50	5	50	90.0	Do.
3	230	23	20	90.0	Jamaica Bay, Big Channel, Canarsie.
4	14	4	60	71.4	Raritan Bay between Great Kills and Princess Bay.
5	14	4	150	71.4	Do.
6	5	3	60	40.0	Do.
7	4	2	50	50.0	Do.
8	14	5	60	64.3	Do.
9	41	4	15	90.2	Raritan Bay, off South Beach.
10	2	1	60	50.0	Raritan Bay between Great Kills and Princess Bay.
11	320	4	25	98.7	Raritan Bay, near Great Beds, Light Amboy.
12	320	3	20	99.0	Jamaica Bay, Sweetwater area near Inwood.
13	320	23	15	92.8	Jamaica Bay, Big Channel, Canarsie.

Discussion and Conclusions.

It will be noted readily that the reduction of *B. coli* following the process is more marked in oysters which were originally more heavily polluted than in those which were but moderately or slightly polluted. This experience confirms and parallels that found in the application of hypochlorite for the purification of water supplies.

In oysters scoring in the neighborhood of 50 or more, an average reduction of 90 per cent of the *B. coli* content can be confidently expected from the process.

It is apparent that an average reduction of 90 per cent in the *B. coli* score of an oyster originally scoring 500, the maximum index of pollution, will just about bring such oysters to the neighborhood of 50, the maximum score allowed for marketable oysters. Since this degree of reduction just about meets sanitary standards, and allows no leeway for a safety factor, it should not be permissible. It is believed that oysters with an original score of 230–320 represent about the maximum pollution which can be safely reduced to an acceptable score and yet provide the desired factor of safety. In other words, in dealing with oysters of known considerable pollution, the rule should be that the greater the original degree of pollution, the greater the allowance should be for a safety factor, in admitting such processed oysters to market.

In a general way, this would permit the marketing of oysters from large oyster-bearing areas now restricted to marketing during the hibernation or other restricted period fixed for such areas, during the entire season, by the use of this process during the season now prohibited.

From the public health standpoint, in an administrative way, the process should be handled in much the same manner that pasteurization of milk is controlled. The ideal plan would be the utilization of a central oyster treatment plant, preferably supervised by State or local authorities. Such a plant could be operated on a cooperative basis by the local oystermen. And, finally, the application of the process by individual oystermen in their local business has been demonstrated to be entirely feasible and desirable, if properly supervised.

Such process treatment of all oysters marketed, regardless of origin, would insure an additional safety factor to public health.